Public Abstract for
"Robust Decentralized Classification and Coordination Algorithms for Swarms of SUAS"

There is a need of real-time systems and algorithms capable of providing decentralized multi-sensor classification and multi-agent coordination in missions subject to variable communications conditions. This is especially important in GPS denied environments performing non-centralized surveillance with non-scheduled coordination. An important challenge of such missions is that current positioning systems operating in GPS denied environments do not fully exploit the prior-knowledge of the terrain while being robust to uncertainty, and they are neither fast nor effective when dealing with high dimensional data. An additional challenge is that conventional systems do not fully take into consideration the instantaneous performance of the communications network or sensing platforms in order to dynamically adapt tasks priorities in multi-agent missions. Another important challenge is that SUAS hardware platforms are severely constrained in terms of on-board processing capability as well as communication range; and state of the art networks do not ensure that the data is efficiently shared among other members of the SUAS swarm, or relayed timely over multiple hops to the ground station (if used) during network operation.

The overarching goal of this proposal is to address the aforementioned challenges by developing a decentralized classification and coordination framework for swarms of Small Unmanned Aerial Systems (SUAS) operating under constrained communications. Our framework relies on (1) advanced detection, classification, and identification algorithms that fuse full motion video with novel onboard radars operating in real-time by using Deep Learning and 4D (space + time) Compressive Sensing (CS); (2) Multi-agent coordination using Multi-Task Reinforcement Learning (RL) in Decentralized Partially Observable Markov Decision Processes (Dec-POMDPs); and (3) a robust aerial architecture orchestrated by a Software Defined Network (SDN) control plane that jointly configures the link, network, and transport layers.